

Publication number : 2001-209057

Date of publication of application : 03.08.2001

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Int.Cl. G02F 1/1339 G02F 1/13

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Application number : 2000-017506

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Date of filing : 26.01.2000

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# DEVICE FOR MANUFACTURING LIQUID CRYSTAL PANEL

## [Abstract]

15 PROBLEM TO BE SOLVED: To surely pressurize substrates to obtain a specified gap by using a rigid body under atmospheric pressure without causing an uneven contact state.

SOLUTION: While a closed space D is evacuated, flat faces 1a, 2a of pressurizing plates 1, 2 move nearer to each other by the atmospheric pressure and bring the  
20 top face 3a of a buffer material 3 in contact with substrates A, B. As a result, the buffer material 3 deforms by compression to make a uniform distance between the flat faces 1a, 2a. By further evacuating, the substrates A, B are uniformly pressurized without adding excess force to the flat faces 1a, 2a of the pressurizing plates 1, 2 through the buffer material 3.

25

[Claims]

[Claim 1] A device for manufacturing a liquid crystal panel in which two substrates A and B are bonded to each other with high precision and are set between pressurizing surfaces 1a and 2a of pressurizing plates 1 and 2 opposite  
5 and parallel to each other and an annular sealing material C disposed to enclose the substrates A and B, a closed space D by contacting circumferential portions of the pressurizing surfaces 1a and 2a to each other is formed, the closed space D and pressurizes the both substrates A and B to obtain a specified gap by the atmospheric pressure are decompressed, and an adhesive E between the both  
10 substrates A and B is hardened, the device comprising: constructing the pressurizing plates 1 and 2 of a rigid body; fixedly disposing one pressurizing plate to be unmovable and supporting the other plate to be reciprocated in the direction of contact and movement; fixing a buffer material 3 opposite to the substrates A and B to one of the pressurizing surfaces 1a and 2a; and deforming by  
15 compression a top face 3a of the buffer material 3 by surface-contacting the top face 3a to the substrates A and B as the closed space D is decompressed.

[Claim 2] The device of claim 1, wherein one pressurizing plate is the top cover 1 supported to be moved upwardly and downwardly, the other pressurizing plate is the fixedly disposed surface plate 2 to be unmovable, and the buffer material 3 is  
20 fixed to the pressurizing surface 1a of the top cover 1.

[Title of the Invention]

Device for Manufacturing Liquid Crystal Panel

[Detailed Description of the Invention]

[0001]

- 5 [Field of the Invention] The present invention relates to a device for manufacturing a liquid crystal panel used in an LCD, and more particularly, to a device for manufacturing a liquid crystal panel which in two substrates bonded to each other with high precision which are set between pressurizing surfaces of pressurizing plates opposite and parallel to each other and an annular sealing
- 10 material disposed to enclose the substrates, forms a closed space by contacting circumferential portions of the pressurizing surfaces to each other, pressurizes both substrates to obtain a specified gap by atmospheric pressure by evacuating the closed space D, and hardens an adhesive between the both substrates.

[0002]

- 15 [Description of the Prior Art] As a conventional device for manufacturing a liquid crystal panel, for example, one as disclosed in Japanese Laid Open No. 2934438, there is a device for manufacturing a liquid crystal panel according to a vacuum press method, in which a pressurizing surface of one pressurizing plate supported to be movable upwardly and downwardly, the pressurizing surface coming in
- 20 contact with substrates, is a flexible film; the pressurizing plate is lowered to make the flexible film in contact with an annular sealing material; a closed shape is formed between said one pressurizing plate and the other pressurizing plate, that is, a fixed surface plate; as the closed space is evacuated, the flexible film deforms and is adhered along the substrate to thereby pressurize the both
- 25 substrates by the atmospheric pressure; and a thermosetting adhesive between

the both substrates is hardened by heating the both substrates in such a state.

[0003]

[Problems to be Solved by the Invention] However, in such a conventional device for manufacturing a liquid crystal panel, since the substrates are pressurized by the atmospheric pressure by using the flexible film, according to a material of the adhesive or rigidity of the flexible film, only the adhesive is not sufficiently pressurized and the both substrates are not pressurized to obtain a specified gap. In addition to the vacuum press method, there is another conventional device for manufacturing a liquid crystal panel according to a rigid body press method, in which pressurizing plates formed of a rigid body move nearer to each other using a mechanical press device and two substrates disposed between the pressurizing plates are pressurized to thereby obtain a specified gap. However, very difficult adjustment is required to move the pressurizing plates nearer to each other in a completely parallel state in order to prevent from coming in contact with only one of the both substrates. In particular, it becomes more difficult as the substrates increase in size, and therefore, in fact, it is impossible to use this conventional device in an apparatus for mass production.

[0004] An object of the present invention as recited in Claim 1 is to pressurize both substrates to obtain a specified gap by using a rigid body under atmospheric pressure without causing an uneven contact state. An object of the present invention as recited in Claim 2 which is added to the object of the present invention as recited in Claim 1 is to simplify a support structure of a top cover and smoothly pressurize both substrates to obtain a specified gap by applying gravity of the top cover as well as atmospheric pressure.

[0005]

[Means for Solving the Problem] In order to achieve the aforementioned objects of the present invention, a device for manufacturing a liquid crystal panel as recited in Claim 1 comprises: constructing the pressurizing plates of a rigid body; fixedly disposing one pressurizing plate to be unmovable and supporting the other plate to be reciprocated in the direction of contact and movement; fixing a buffer material opposite to the substrates to one of the pressurizing surfaces; and deforming by compression a top face of the buffer material by surface-contacting the top face to the substrates according to evacuation of the closed space. In addition to the structure of Claim 1, in the device for manufacturing the liquid crystal panel as recited in Claim 2, one pressurizing plate is the top cover supported to be movable upwardly and downwardly, the other pressurizing plate is the fixedly disposed surface plate to be unmovable, and the buffer material is fixed to the pressurizing surface of the top cover.

[0006]

15 [Operation]

In the present invention of Claim 1, as the closed space is evacuated, flat faces of pressurizing plates move nearer to each other under atmospheric pressure and a top face of a buffer material is pressurized and comes in contact with substrates. As a result, the buffer material deforms by compression to make a uniform distance between the flat faces. By further evacuation, the substrates are uniformly pressurized without adding excess force to the flat faces of the pressurizing plates through the buffer material. In the present invention of Claim 2, a construction that one pressurizing plate is the top cover supported to be movable upwardly and downwardly, the other pressurizing plate is the surface plate fixedly disposed to be unmovable, and the buffer material is fixed to the

pressurizing surface is added to the construction recited in Claim 1. Accordingly, as the closed space is evacuated, the top cover is lowered by the atmospheric pressure and gravity of the top cover to thereby pressurize and contact the top face of the buffer material to the substrates. As a result, the buffer material  
5 deforms by compression to equalize thickness ununiformity between the pressurizing surface of the top cover and the substrates. By further evacuation, the pressurizing surface of the top cover formed of the rigid body uniformly pressurizes the substrates along the pressurizing surface of the surface plate without excess force in all direction being applied thereto.

10 [0007]

[Embodiment of the Invention] The preferred embodiments of the present invention will now be described in detail with reference to the accompanying drawings. As illustrated in Figure 1 and Figure 2, one pressurizing plate is a top cover 1 supported to be movable upwardly and downwardly, the other pressurizing  
15 plate is a surface plate 2 fixedly disposed to be unmovable, two glass substrates A and B bonded to each other with high precision in the air are set on the surface plate 2, and the top cover 1 is lowered to be in contact with an annular sealing material C, a closed space D enclosed by the annular sealing material C is formed between the top cover 1 and the surface plate 2, and an adhesive E formed of  
20 thermosetting resin between the substrates A and B is heated and hardened.

[0008] The top cover 1 is composed of a rigid body such as carbon, and is supported to be freely reciprocated by a lifting/lowering device such a driving cylinder not illustrated in the drawing. At least after the top cover 1 is lowered and comes in contact with an annular sealing material C, a link with the lifting device is  
25 released and therefore can move up and down.

[0009] In addition, the buffer material 3 to come in contact with the substrates A and B is adhered to a pressurizing surface 1a of the top cover 1. The buffer material 3 is composed of a material having excellent thermal resistance (above 100°C), such as silicon rubber foam or a material having better durability than it  
5 such that the buffer material 3 hardens the thermosetting adhesive E.

As for the thickness, when the pressurizing surface 1a of the top cover 1 is in contact with the annular sealing material C, the top face 3a does not come in contact with an upper end surface of the substrates A and B with a gap interposed therebetween. At the same time, when the top cover 1 can be pressurized by  
10 atmospheric pressure as the closed space D enclosed by the annular sealing material C is evacuated, the top face 3a deforms by compression by contacting the top face with the upper end surface of the substrates A and B, as shown in Figure 1(b).

[0010] In addition, a heating/cooling unit 4 is installed between the pressurizing  
15 surface of the top cover 1 and the buffer material 3. In order to insulate the heating/cooling unit 4, the top cover 1 is formed of a material having excellent insulation. Though not illustrated, an insulating material may be interposed between the pressurizing surface 1a of the top cover 1 and the heating/cooling unit 4. In case of the present embodiment, a platy heater that radiates by being  
20 conducted and a metal plate having a plurality of cooling pipes through which coolant passes are stacked to have a sheet shape.

[0011] In the present embodiment, a buffer material 3a' softer than the annular sealing material C is installed at a circumferential portion opposite to the annular sealing material C of the pressurizing surface 1a of the top cover 1. When the top  
25 cover 1 can be lowered under atmospheric pressure since the closed space C is

evacuated, the buffer material 3' deforms by compression before the annular sealing material C. Then, the top face 3a of the buffer material 3 comes in contact with the upper end surface of the substrates A and B, and deforms by compression.

5 [0012] The substrates A and B include a color filter and a TFT substrate having a desired pattern thereon. The adhesive E of a thermosetting resin is used in one of the substrates. The adhesive E is coated in a shape of a frame whose part is opened as an injection hole E1. A plurality of spacers F are dispersed onto one substrate. Then, the substrates A and B are position-aligned with high precision in  
10 the air and are bonded to each other. Though only one frame generated by the adhesive E exists as illustrated in Figure 1 and Figure 2, but, not limited to this, a plurality of frames formed by the adhesive E may be disposed between the substrates A and B if the substrates A and B has a large size.

[0013] The surface plate 2 is integrally formed of a heat resisting material, e.g.,  
15 carbon, that has high rigidity and the same degree of a rate of thermal expansion as the substrates A and B. The surface plate 2 a thickness such that it does not easily deform though the surface plate 2 is heated or cooled by a heating unit 5 or a cooling unit 6 which is buried therein.

[0014] The heating unit 5 and the cooling unit 6 are buried closely to each other  
20 on the plane. In the present embodiment, as shown in Figures 1 and 2, the heating unit 5 and the cooling unit 6 having a linear shape as a plurality of lines are alternately disposed at upper and lower middle of the surface plate 2 in the horizontal direction by a predetermined pitch such as 50 to 60mm. A linear heater which radiates by being conducted is used as the heating unit 5. A cooling pipe  
25 through which coolant passes is used as the cooling unit 6.

[0015] In addition, since an outer edge portion radiates and thus is likely to be cooled down in comparison to the center portion, a temperature of the heating unit 5 is set such that heating temperature increases from the center portion toward the outer edge portion. The entire pressurizing surface 2a of the surface plate 2 is controlled at uniform temperature.

[0016] In addition, the annular sealing material C such as O ring is opposite to the pressurizing surface 1a of the top cover 1 and is mounted on the pressurizing surface 2a of the surface plate 2. The substrates A and B are set at a fixed position inside the annular sealing material C through a position determining means (not illustrated) such as a frame. A suction path 2b is installed in the surface plate 2 so as to communicate with a space between the annular sealing material C and the substrates A and B. Suction and exhaust are performed from the inside of the annular sealing material C.

[0017] Next, the operation of the device for manufacturing a liquid crystal panel will be described. First, as an initial step, the surface plate 2 is maintained at a temperature which does not affect the adhesive E, for example, below 60°C, the top cover 1 is lifted up, and the substrates A and B are set on the surface plate 2. Thereafter, as shown in Figure 1(a), the top cover is lowered by gravity or by the driving of the cylinder to thereby come in contact with the annular sealing material C, whereby the closed space D enclosed by the annular sealing material C is formed between the top cover 1 and the surface plate 2.

[0018] Thereafter, suction and exhaust are started from the suction path 2b of the surface plate 2, and the closed space D is evacuated. Thus, as shown in Figure 1(b), the top cover 1 is slowly lowered under atmospheric pressure, and the top face 3a is pressurized and comes in contact with the substrates A and B and

deforms by compression. As a result, regardless of flatness of the pressurizing surface of the substrates A and B, thickness ununiformity between the pressurizing surface 1a of the top cover 1 and the upper end of the substrates A and B is equalized. Accordingly, the substrates A and B can be completely parallel to each other and be pressurized surely to obtain a specified gap.

[0019] In addition, according to evacuation of the closed space D, air remaining between the both substrates A and B, more specifically, air remaining inside air E 2 for sealing liquid crystals which is enclosed by the adhesive E is removed from the liquid crystal injection hole E1 which is a path formed at part of the adhesive E.

10 Accordingly, the air remaining inside the space for sealing the liquid crystals does not act as a force against pressurization of the substrates A and B, and therefore the substrates A and B can be smoothly pressurized to obtain the specified gap.

[0020] In addition, at a point of time when the substrates A and B are pressurized nearly to obtain the specified gap, the heating/cooling unit 4 of the top cover 1 and

15 the heating unit 5 of the surface plate 2 are conducted to thereby uniformly increase the temperature of the substrates A and B to soften the adhesive E. The temperature control is performed until the specified gap is taken out and hardened.

[0021] At this time, since the surface plate 2 is integrally formed of a heat-resisting material that has high rigidity and the same rate of heat expansion as the

20 substrates A and B, the surface plate 2 does not deform by heat and maintains its shape. At the same time, since the heating units 5 therein are buried closely to each other on the plane, the entire pressurizing surface 2a of the surface plate 2 is uniformly and quickly heated. Accordingly, heat can be uniformly and quickly conducted from the surface plate 2 to the entire substrates A and B.

25 [0022] After the adhesive E has been completely hardened, the suction and

exhaust from the suction path 2b of the surface plate 2 are stopped, water-cooling is performed by sending water to the respective cooling pipes of the heating/cooling unit 4 of the top cover 1 and the cooling unit 6 of the surface plate 2. Then, the substrates A and B are drawn out by lifting up the top cover 1.

5    Thereafter, the above-described processes are repeated.

[0023] Figure 3 and Figure 4 illustrate another embodiments of the present invention, respectively. In Figure 3, a protrusion portion 1' that takes the place of the buffer material 3 softer than the annular sealing material C installed at the circumferential portion of the pressurizing surface 1a opposite to the annular sealing material C and is harder than the annular sealing material C is extendedly installed at the circumferential portion of the pressurizing surface 1a. When the pressurizing surface 1a of the top cover 1 is in contact with the annular sealing material C, as shown in Figure 3(a), the top face 3a of the buffer material 3 is not in contact with the upper end surface end of the substrates A and B with a gap interposed therebetween. However, when the top cover 1 can be pressurized by atmospheric pressure as the closed space D enclosed by the annular sealing material C is evacuated, the top face 3a of the buffer material 3 comes in contact with the upper end surface of the substrates A and B and deforms by compression with a range that the annular sealing material C is pressed as shown in Figure 3(b), and this construction is different from the embodiment shown in Figure 1 and Figure 2. Other construction is the same as the embodiment shown in Figure 1 and Figure 2.

[0024] Accordingly, since the buffer material 3 is not required to be fixed later if the protrusion portion 1' is integrally formed on the circumferential portion of the pressurizing surface 1a, the top cover 1 can be more easily manufactured in the

embodiment of Figure 3 compared to the embodiment shown in Figure 1 and Figure 2.

[0025] In another embodiment of Figure 4, a structure of the surface plate 2 is divided into an upper member 2c and a lower member 2d as disclosed in Japanese Laid Open No. 2934438, the cooling unit 6 is buried in the upper member 2c, the heating unit 5 is installed in the lower member 2d, and the heating unit 5 of the lower substrate 2d is operated in a state that the substrates A and B are pressurized. The substrates A and B are heated by thermal conduction from the lower substrate 2d with the upper substrate 2c located therebetween, and when cooling the substrates after the heating, the upper member 2d is separated from the upper substrate 2C. The upper substrate 2c is quickly cooled. This construction is different from the embodiment shown in Figures 1 and 2. Other construction is the same as the embodiment shown in Figures 1 and 2.

[0026] Accordingly, in the embodiment of Figure 4, the substrates A and B can be surely pressurized to obtain the specified gap by using a rigid body under atmospheric pressure without causing an uneven contact state like the embodiment of the Figures 1 and 2.

[0027] In addition, in the preferred embodiments, one pressurizing plate is the top cover 1 supported to be movable upwardly and downwardly, the other pressurizing plate is the surface plate 2 fixedly disposed to be unmovable, two glass substrates A and B bonded to each other with high precision in the air are positioned on the surface plate 2 and come in contact with the annular sealing material C by lowering the top cover 1, and the closed space D enclosed by the annular sealing material C is formed between the top cover 1 and the surface plate 2. However, not limited to this construction, in opposition to this, the upper

pressurizing plate is the fixed surface plate, the lower pressurizing plate is the movable surface plate supported to be movable upwardly and downwardly, the closed space D enclosed by the annular sealing material C is formed by lifting up the movable surface plate, the movable surface plate C can be moved upwardly  
5 by the atmospheric pressure as the closed space D is evacuated, and the substrates A and B are pressurized through the buffer material fixed to the pressurizing surface of the movable substrate. In this case, the suction path for suction and exhaust is installed at the fixed surface plate, preferably.

[0028] In addition, in the previous preferred embodiments, the thermosetting  
10 adhesive E between the substrates A and B is heated and hardened. However, not limited to this, another adhesive such as an ultraviolet hardening may be used.

[0029] [Effect of the Invention] As described so far, the invention of claim 1 recited in the present invention, the closed space is evacuated and the flat faces of the pressurizing plates move nearer to each other by the atmospheric pressure  
15 to pressurizing and contacting the upper end surface of the buffer material to the substrates. As a result, the buffer material deforms by compression to thereby equalize the thickness ununiformity between the flat faces of the pressurizing plates and the upper end surface. By subsequent evacuation, since the flat faces of the pressurizing plates uniformly press the substrates in a parallel state through  
20 the buffer material without adding excess thereto, the substrates are pressurized surely to obtain the specified gap by using a rigid body without carrying out the two substrates individually. Accordingly, compared to the conventional one in which the substrates are pressurized by the atmospheric pressure with the flexible film interposed therebetween, only the adhesive can be sufficiently pressed regardless  
25 of what the adhesive is formed of and therefore the both substrates are

pressurized to obtain the specified gap. In addition, compared to the rigid body press method requires very difficult adjustment to move the pressurizing plate nearer to each other in a complete parallel state in order not to cause an uneven contact state, the invention of claim 1 can correspond to substrates increasing in size without adjustment of flatness and therefore is effective in a mass-production apparatus. In addition, as the closed space is evacuated, air remaining between the both substrates, more specifically, air remaining inside the space for sealing liquid crystals which is enclosed by the adhesive can be taken out from the liquid crystal injection hole which is the path formed at part of the adhesive. The air remaining inside the space for sealing liquid crystals does not act as a force against pressurization of the substrates and the substrates can be pressurized to obtain the specified gap.

[0030] In addition to the effect of invention of claim 1, in the claim 2 invention, as the closed space is evacuated, the top cover is lowered by the atmospheric pressure and gravity of the top cover to thereby pressurize and contact the upper end surface of the buffer material to the substrates. As a result, the buffer material deforms by compression thickness ununiformity between the pressurizing surface of the top cover and the substrates is equalized. Since by subsequent evacuation, the pressurizing surface of the top cover formed of a rigid body uniformly presses the substrates along the pressurizing surface of the surface plate without adding excess force in all direction thereto, a support structure of the top cover can be simplified and the both substrates can be smoothly pressurized to obtain the specified gap with the gravity of the top cover as well as the atmospheric pressure being applied. Accordingly, the entire substrate does not increase in size and manufacturing costs can be reduced. In addition, since the pressurizing surface of

the top cover has the buffer material thereon is not in contact with the substrates, precise flatness is not required and costs for manufacturing the top cover can be reduced.

[Description of Drawings]

5 [Fig. 1] is a longitudinal front view illustrating a device for manufacturing a liquid crystal panel in accordance with one embodiment of the present invention, wherein Fig. 1(a) shows a state before evacuation and Fig. 1(b) shows when substrates are pressurized by the evacuation.

[Fig. 2] is a cross-sectional plan view taken along line (2)-(2) of Figure 1(a).

10 [Fig. 3] is a longitudinal front view illustrating a device for manufacturing a liquid crystal panel in accordance with another embodiment of the present invention, wherein Fig. 3(a) shows a state before evacuation and Fig.3(b) shows when substrates are pressurized by the evacuation.

[Fig.4] is a longitudinal front view illustrating a device for manufacturing a liquid  
15 crystal panel in accordance with still another embodiment of the present invention, wherein a state before evacuation is shown.

[Explanation of Reference Numerals] A and B substrates, C annular sealing material, D closed space, E adhesive, 1 pressurizing plate (upper top cover), 2 pressurizing plate (surface plate), 1a and 2a pressurizing surfaces, 3 buffer  
20 material, 3a top face

(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開2001-209057

(P2001-209057A)

(43) 公開日 平成13年8月3日(2001.8.3)

(51) Int.Cl. <sup>7</sup>	識別記号	F I	チーフワード(参考)
G 0 2 F 1/1339	5 0 5	C 0 2 F 1/1339	5 0 5 2 H 0 8 8
1/13	1 0 1	1/13	1 0 1 2 H 0 8 9

審査請求 有 請求項の数 2 O L (全 6 頁)

(21) 出願番号 特願2000-17506(P2000-17506)

(22) 出願日 平成12年1月26日(2000.1.26)

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Fターム(参考) 2H088 FA01 FA20 FA30 HA08 HA12

2H089 NA24 NA43 NA60 QA14 TA09

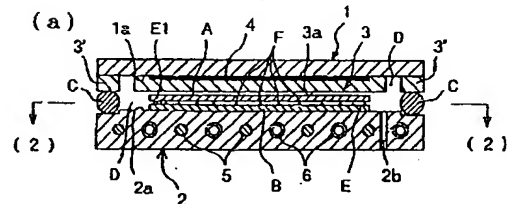
TA12

(54) 【発明の名称】 液晶パネル製造装置

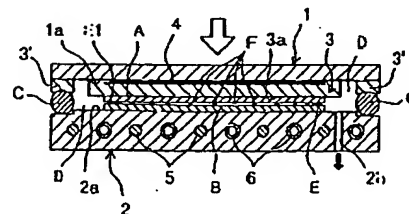
(57) 【要約】

【課題】 大気圧により剛体で両基板を片当たりせずに所定ギャップまで確実に押し潰す。

【解決手段】 閉空間D内の減圧に伴って、大気圧により加圧板1、2の平坦面1a、2aが接近移動して緩衝材3の先端面3aを基板A、Bに圧接させ、その結果、該緩衝材3が圧縮変形して平坦面1a、2aの間の厚みむらを平均化し、それ以降の減圧により、緩衝材3を介して加圧板1、2の平坦面1a、2aは余計な力がかからずに基板A、Bを平行のまま均等に押す。



(b)



## 【特許請求の範囲】

【請求項1】 平行に対向する加圧板（1、2）の加圧面（1a、2a）間に、精度良く貼り合わされた2枚の基板（A、B）をセットし、この基板（A、B）を囲むように配置された環状シール材（C）に対し、上記加圧面（1a、2a）の周縁部を夫々接触させて閉空間

（D）が形成され、この閉空間（D）の内部を減圧して大気圧により両基板（A、B）を加圧させ所定のギャップまで潰しながら、両基板（A、B）間の接着剤（E）を硬化させる液晶パネル製造装置において、前記加圧板（1、2）を剛体で構成して、その一方を移動不能に固定配置すると共にこれに対して他方を接離する方向へ往復動自在に支持し、これら加圧面（1a、2a）のどちらか一方には、基板（A、B）と対向する緩衝材（3）を固着し、閉空間（D）内の減圧に伴って上記緩衝材（3）の先端面（3a）を、基板（A、B）に面接触して圧縮変形させることを特徴とする液晶パネル製造装置。

【請求項2】 前記加圧板の一方が昇降自在に支持した上蓋（1）であり、他方の加圧板が移動不能に固定配備した定盤（2）であり、上蓋（1）の加圧面（1a）に緩衝材（3）を固着した請求項1記載の液晶パネル製造装置。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】本発明は、液晶ディスプレイ（LCD）に使用する液晶パネルの製造装置に関する。詳しくは、平行に対向する加圧板の加圧面間に、精度良く貼り合わされた2枚の基板をセットし、この基板を囲むように配置された環状シール材に対し、上記加圧面の周縁部を夫々接触させて閉空間が形成され、この閉空間の内部を減圧して大気圧により両基板を加圧させ所定のギャップまで潰しながら、両基板間の接着剤を硬化させる液晶パネル製造装置に関する。

## 【0002】

【従来の技術】従来、この種の液晶パネル製造装置として、例えば特許第2934438号公報に開示される如く、一方の加圧板が昇降自在に支持されて基板と当接する加圧面が可撓性フィルムであり、この加圧板の下降により可撓性フィルムを環状シール材に接触させて、他方の加圧板である固定定盤との間に閉空間が形成され、この閉空間の内部を減圧することにより、大気圧で可撓性フィルムが基板に沿うように変形密着して両基板を加圧し、この状態で両基板を加熱して両基板間の熱硬化性接着剤を硬化させる真空プレス方式のものがある。

## 【0003】

【発明が解決しようとする課題】しかし乍ら、このような従来の液晶パネル製造装置では、可撓性フィルムを介して大気圧により基板を加圧するため、接着剤の材料や可撓性フィルムの硬度等によっては、接着剤のみを十分

に押し切れずに両基板が所定のギャップまで潰れない状態が起きる恐れがあるという問題がある。また、この真空プレス方式以外の液晶パネル製造装置として、剛体からなる加圧板を、機械的なプレス機構で接近移動させることにより、これらの間に配置された2枚の基板を加圧して所定のギャップまで潰す従来周知の剛体プレス方式のものがある。しかし、この剛体プレス方式のものは、両基板の片当たりを避けるため、加圧板を完全な平行状態で接近移動させるには、非常に難しい調整が必要となり、特に基板が大型化すればするほど難しくなって、量産機では事実上不可能となるという問題がある。

【0004】本発明のうち請求項1記載の発明は、大気圧により剛体で両基板を片当たりせずに所定ギャップまで確実に押し潰すことを目的としたものである。請求項2記載の発明は、請求項1に記載の発明の目的に加えて、上蓋の支持構造を簡素化できると共に大気圧だけでなく上蓋の重力も加わって両基板を所定ギャップまでスムーズに潰すことを目的としたものである。

## 【0005】

【課題を解決するための手段】前述した目的を達成するために、本発明のうち請求項1記載の発明は、前記加圧板を剛体で構成して、その一方を移動不能に固定配置すると共にこれに対して他方を接離する方向へ往復動自在に支持し、これら加圧面のどちらか一方には、基板と対向する緩衝材を固着し、閉空間内の減圧に伴って上記緩衝材の先端面を、基板に面接触して圧縮変形させることを特徴とするものである。請求項2記載の発明は、請求項1記載の発明の構成に、前記加圧板の一方が昇降自在に支持した上蓋であり、他方の加圧板が移動不能に固定配備した定盤であり、上蓋の加圧面に緩衝材を固着した構成を加えたことを特徴とする。

## 【0006】

【作用】請求項1の発明は、閉空間内の減圧に伴って、大気圧により加圧板の平坦面が接近移動して緩衝材の先端面を基板に圧接させ、その結果、該緩衝材が圧縮変形して平坦面の間の厚みむらを平均化し、それ以降の減圧により、緩衝材を介して加圧板の平坦面は余計な力がかからずに基板を平行のまま均等に押すものである。請求項2の発明は、請求項1記載の構成に対して、前記加圧板の一方が昇降自在に支持した上蓋であり、他方の加圧板が移動不能に固定配備した定盤であり、上蓋の加圧面に緩衝材を固着した構成を追加したので、閉空間内の減圧に伴って、大気圧と上蓋の重力により該上蓋が下降して緩衝材の先端面を基板に圧接させ、その結果、この緩衝材が圧縮変形して、上蓋の加圧面と基板との間の厚みむらを平均化し、それ以降の減圧により、剛体からなる上蓋の加圧面は左右上下の余計な力がかからずに基板を定盤の加圧面に習って均等に押す。

## 【0007】

【発明の実施の形態】以下、本発明の実施例を図面に基

づいて説明する。この実施例は、図1～図2に示す如く、加圧板の一方が昇降自在に支持した上蓋1であると共に、他方の加圧板が移動不能に固定配備した定盤2であり、大気中で精度良く貼り合わされた2枚のガラス製基板A、Bを定盤2上にセットし、上蓋1を下降して環状シール材Cに接触させることにより、上蓋1と定盤2との間に環状シール材Cで囲まれた閉空間Dが形成され、更に基板A、B間の熱硬化性樹脂からなる接着剤Eを加熱して硬化させる場合を示すものである。

【0008】上蓋1は、例えばカーボンなどの剛体で構成し、図示しない例えば駆動シリンダーなどの昇降機構により往復動自在に支持されるが、少なくとも該上蓋1を下降させて環状シール材Cに接触した以降は、上記昇降機構との連係を解放して自由に昇降可能となるように支持している。

【0009】また、この上蓋1の加圧面1aには、基板A、Bと当接する緩衝材3が固着される。この緩衝材3は、両基板A、B間の熱硬化性接着剤Eを硬化させるため耐熱性（100℃以上）に優れた例えばシリコン発泡ゴムやそれより耐久性に優れた材料などで構成される。その厚さ寸法は、前記上蓋1の加圧面1aが環状シール材Cに接触した時点では、図1(a)に示す如くその先端面3aが基板A、Bの上端面と間隙を介して不接触であるとと共に、上記環状シール材Cに囲まれた閉空間D内の減圧により、上蓋1が大気圧で押し下げられた時には、図1(b)に示す如く先端面3aを基板A、Bの上端面に接触させて圧縮変形するように設定する。

【0010】更に、この上蓋1の加圧面1aと緩衝材3との間には、加熱・冷却手段4を配設し、この加熱・冷却手段4の熱を逃がさないように、該上蓋1自体を断熱性に優れた材料で形成するか、或いは図示せぬが、これら上蓋1の加圧面1aと加熱・冷却手段4との間に断熱材を介在させる。加熱・冷却手段4としては、本実施例の場合、通電により発熱する面状ヒーターと、冷却水が通る複数の冷却パイプが内蔵された金属板とを薄板状に積層して構成している。

【0011】本実施例では、上蓋1の加圧面1aの環状シール材Cと対向する周縁部には、環状シール材Cより柔らかい緩衝材3'を配設し、閉空間D内の減圧により上蓋1が大気圧で押し下げられた際には、環状シール材Cより先に周縁緩衝材3'が圧縮変形して上記緩衝材3の先端面3aを基板A、Bの上端面に接触させて圧縮変形するように設定している。

【0012】前記基板A、Bは、例えば所望のパターンが形成されたカラーフィルターとTFT基板からなり、その一方の基板に熱硬化性樹脂製の接着剤Eを使用し、接着剤Eを、その一部が液晶注入孔E1として開口する枠状に塗布し、他方の基板には多数のスペーサFを散布した後、大気中で精度良く位置合わせして貼り合わされる。図1～図2に示したものは、接着剤Eによる枠が一

つしか存在しないが、これに限定されず、基板A、Bが大型であれば、その間に接着剤Eの枠を複数配置させることもできる。

【0013】一方、前記定盤2は、剛性が高く基板A、Bと同程度の熱膨張率を有する耐熱性材料、例えばカーボンなどで一体的に形成され、その内部に埋設した加熱手段5で加熱したり、冷却手段6で冷却しても簡単に変形しない厚さ寸法に形成する。

【0014】これら加熱手段5と冷却手段6は、平面的に密な状態でしかも互いに接近させて埋設する。本実施例の場合には、図1及び図2に示す如く定盤2の上下中間位置に、直線状の加熱手段5及び冷却手段6を水平方向へ所定ピッチ、例えば50～60mmで交互に接近させて夫々複数本ずつ配置し、加熱手段5としては通電により発熱する線状ヒーターを使用し、冷却手段6としては冷却水が通る冷却パイプを使用している。

【0015】また、定盤2の中央部分に比べて外周部分の方は、放熱されて冷え易いため、中央部分の加熱温度より外周部分の加熱温度が高くなるように上記加熱手段5を温度設定して、定盤2の加圧面2a全体が均一温度となるように制御することも可能である。

【0016】更に、上記定盤2の加圧面2aには、前記上蓋1の加圧面1aと対向して例えばOリングなどの環状シール材Cが取り付けられ、この環状シール材Cの内側には、図示しない枠などの位置決め手段を介して前記基板A、Bが定位位置にセットされる。これら環状シール材Cと基板A、Bとの空間に連通するように吸引通路2bを定盤2に開設し、この吸引通路2bによって環状シール材Cの内側から吸引排気するように構成している。

【0017】次に、斯かる液晶パネル製造装置の作動について説明する。まず、初期状態で定盤2は、接着剤Eに影響を与えない温度、例えば60℃以下に保っておき、上蓋1を上昇させて、基板A、Bを定盤2上にセットする。このセットが終了した後は、図1(a)に示す如く上蓋1を重力又はシリンダー駆動により下降させて環状シール材Cに接触し、それにより、上蓋1と定盤2との間に環状シール材Cで囲まれた閉空間Dが形成される。

【0018】その後、定盤2の吸引通路2bから吸引排気を開始して、上記閉空間D内を減圧させる。それにより、図1(b)に示す如く上蓋1が大気圧で徐々に押し下げられ、緩衝材3の先端面3aが基板A、Bに圧接して圧縮変形する。その結果、上蓋1の加圧面1aの平面度と関係なく、上蓋1の加圧面1aと基板A、Bの上端面との間の厚みむらが平均化される。従って、基板A、Bを完全な平行状態に保ちながら所定のギャップまで確実に押圧できる。

【0019】また、閉空間Dの減圧に伴って両基板A、Bの間に残った空気、詳しくは、接着剤Eにより囲まれた液晶封入用空間E2内に残った空気が、該接着剤Eの

一部に開口した液晶注入孔E 1から抜き出される。従って、液晶封入用空間E 2内に残った空気が基板A、Bの加圧に対する反力とならず、所定ギャップまでスムーズに潰せる。

【0020】そして、これら基板A、Bが所定ギャップ近くまで潰れた時点で、上蓋1の加熱・冷却手段4と定盤2の加熱手段5とに通電し、均一に基板A、Bの温度を上げ、接着剤Eを軟化させて所定のギャップを出し、硬化するまで温度コントロールを行う。

【0021】この際、定盤2を剛性が高く基板A、Bと同程度の熱膨張率を有する耐熱性材料で一体的に形成したから、熱による変形が発生せずに形状保持されると共に、その内部に加熱手段5を平面的に密な状態でしかも互いに接近させて埋設したから、定盤2の加圧面2a全体が均一に急速加熱される。従って、定盤2から素早く基板A、Bの全体へ均一に熱伝導できる。

【0022】上記接着剤Eの硬化が終了した後は、定盤2の吸引通路2bからの吸引排気を停止させ、上蓋1の加熱・冷却手段4と定盤2の冷却手段6の冷却パイプに夫々通水して水冷し、その後、上蓋1を上昇して基板A、Bを取り出し、それ以降は上述した作業を繰り返す。

【0023】一方、図3と図4に示すものは、夫々が本発明の他の実施例である。図3のものは、前記環状シール材Cと対向する上蓋1の加圧面1aの周縁部に配設した環状シール材Cより柔らかい緩衝材3'に代えて、環状シール材Cより硬い突起部1'を加圧面1aの周縁部に連設し、上蓋1の加圧面1aが環状シール材Cに接触した時点では、(a)に示す如く緩衝材3の先端面3aが基板A、Bの上端面と間隙を介して不接触であるが、上記環状シール材Cに囲まれた閉空間D内の減圧により、上蓋1が大気圧で押し下げられた時には、(b)に示す如く環状シール材Cが潰れる範囲内で、上記緩衝材3の先端面3aを基板A、Bの上端面に接触して圧縮変形させた構成が、前記図1～図2に示した実施例とは異なり、それ以外の構成は図1～図2に示した実施例と同じものである。

【0024】従って、図3に示すものは、前記図1～図2に示した実施例よりも加圧面1aの周縁部に突起部1'を一体的に形成すれば、緩衝材3'を後から固着する必要がないので、その分だけ上蓋1の製造が容易になるという利点がある。

【0025】図4のものは、前記定盤2の構造が特許第2934438号公報に記載されるような上層部材2cと下層部材2dに2分割され、その上層部材2cには冷却手段6を埋設し、下層部材2dには加熱手段5を装備して、基板A、Bの加圧状態で、下層部材2dの加熱手段5を動作させることにより、下層部材2dからの熱伝導で上層部材2cを介して基板A、Bが加熱され、加熱成形後の冷却時は上層部材2cから下層部材2dを切り

離すことにより、上層部材2cが急速冷却される構成が、前記図1～図2に示した実施例とは異なり、それ以外の構成は図1～図2に示した実施例と同じものである。

【0026】従って、図4に示すものも、前記図1～図2に示した実施例と同様に、大気圧により剛体で両基板A、Bを片当たりせずに所定ギャップまで確実に押し潰せることに変わりない。

【0027】尚、前記実施例では、加圧板の一方が昇降自在に支持した上蓋1であると共に、他方の加圧板が移動不能に固定配備した定盤2であり、大気中で精度良く貼り合わされた2枚のガラス製基板A、Bを定盤2上にセットし、上蓋1を下降して環状シール材Cに接触させることにより、上蓋1と定盤2との間に環状シール材Cで囲まれた閉空間Dが形成される場合を示した。しかし、これに限定されず、これとは逆に上方の加圧板が固定定盤であると共に下方の加圧板が昇降自在に支持した可動定盤であり、この可動定盤を上昇して環状シール材Cで囲まれた閉空間Dが形成され、この閉空間E内の減圧により、大気圧で可動定盤Cが押し上げられ、可動定盤の加圧面に固着された緩衝材を介して基板A、Bが加圧されるようにしても良い。この場合には、上記固定定盤に吸引排気用の吸引通路を開設することが好ましい。

【0028】また前記実施例では、基板A、B間の熱硬化性接着剤Eを加熱して硬化させたが、これに限定されず、それ以外に例えば紫外線硬化型などの他の接着剤を使用しても良い。

【0029】

【発明の効果】以上説明したように、本発明のうち請求項1記載の発明は、閉空間内の減圧に伴って、大気圧により加圧板の平坦面が接近移動して緩衝材の先端面を基板に圧接させ、その結果、該緩衝材が圧縮変形して平坦面の間の厚みむらを平均化し、それ以降の減圧により、緩衝材を介して加圧板の平坦面は余計な力がかからずに基板を平行のまま均等に押すので、大気圧により剛体で両基板を片当たりせずに所定ギャップまで確実に押し潰せる。従って、可撓性フィルムを介して大気圧により基板を加圧する従来のものに比べ、接着剤の材料に関係なく接着剤のみを十分に押し切れて両基板が所定のギャップまで潰れる。更に、両基板の片当たりを避けるために加圧板を完全な平行状態で接近移動させるには非常に難しい調整が必要となる剛体プレス方式のものに比べ、特に基板が大型化しても平行度の調整なしで対応でき、量産機でも有効である。また、閉空間の減圧に伴って両基板の間に残った空気、詳しくは、接着剤により囲まれた液晶封入用空間内に残った空気を、該接着剤の一部に開口された液晶注入孔から抜き出せて、液晶封入用空間内に残った空気が基板の加圧に対する反力とならず、所定ギャップまでスムーズに潰せる。

【0030】請求項2の発明は、請求項1の発明の効果

に加えて、閉空間内の減圧に伴って、大気圧と上蓋の重力により該上蓋が下降して緩衝材の先端面を基板に圧接させ、その結果、この緩衝材が圧縮変形して、上蓋の加圧面と基板との間の厚みむらを平均化し、それ以降の減圧により、剛体からなる上蓋の加圧面は左右上下の余計な力がかからずに基板を定盤の加圧面に習って均等に押すので、上蓋の支持構造を簡素化できると共に大気圧だけでなく上蓋の重力も加わって両基板を所定ギャップまでスムーズに潰せる。従って、装置全体が大型化せず、製造コストを低減できる。また、緩衝材が固着される上蓋の加圧面は基板と接触しないので、精密な平坦度が必要とならず、上蓋の製造コストを低減できる。

#### 【図面の簡単な説明】

【図1】 本発明の一実施例を示す液晶パネル製造装置の縦断正面図であり、(a)は減圧前の状態を示し、

(b)は減圧による基板の加圧時を示している。

【図2】 図1(a)の(2)-(2)線に沿える同横断平面図である。

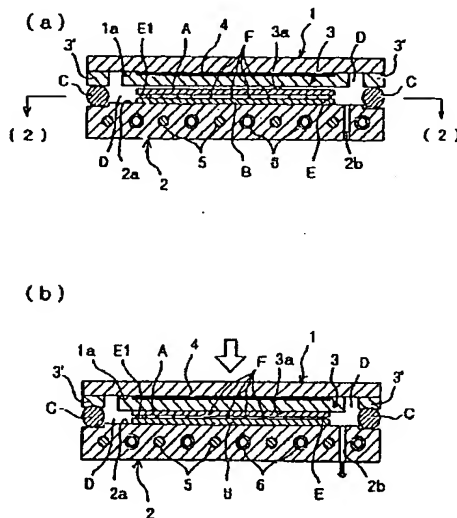
【図3】 本発明の他の実施例を示す液晶パネル製造装置の縦断正面図であり、(a)は減圧前の状態を示し、(b)は減圧による基板の加圧時を示している。

【図4】 本発明の他の実施例を示す液晶パネル製造装置の縦断正面図であり、減圧前の状態を示している。

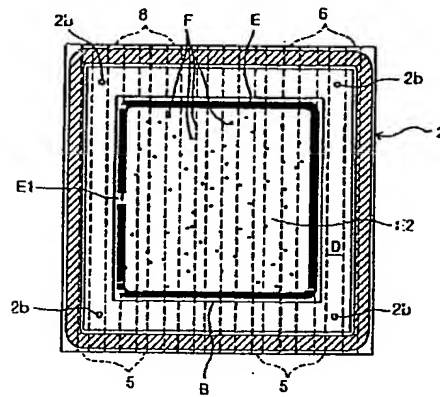
#### 【符号の説明】

- |        |         |   |         |
|--------|---------|---|---------|
| A, B   | 基板      | C | 環状シール材  |
| D      | 閉空間     | E | 接着剤     |
| 1      | 加圧板(上蓋) | 2 | 加圧板(定盤) |
| 1a, 2a | 加圧面     | 3 | 緩衝材     |
| 3a     | 先端面     |   |         |

【図1】



【図2】



【図4】

